INL/CON-05-00564
PREPRINT

The Integrated Waste Tracking System (IWTS) – A Comprehensive Waste Management Tool

The 10th International Conference On Environmental Remediation And Radioactive Waste Management, 2005

Robert S. Anderson
Kirk Green

September 2005

The INL is a
U.S. Department of Energy
National Laboratory
operated by
Battelle Energy Alliance

THE INTEGRATED WASTE TRACKING SYSTEM (IWTS) – A COMPREHENSIVE WASTE MANAGEMENT TOOL

Robert S. Anderson
Kirk Green
Idaho National Laboratory (INL)

ABSTRACT

The US Department of Energy (DOE) Idaho National Laboratory (INL) site located near Idaho Falls, ID USA, has developed a comprehensive waste management and tracking tool that integrates multiple operational activities with characterization data from waste declaration through final waste disposition. The Integrated Waste Tracking System (IWTS) provides information necessary to help facility personnel properly manage their waste and demonstrate a wide range of legal and regulatory compliance. As a client-server database system, the IWTS is a proven tracking, characterization, compliance, and reporting tool that meets the needs of both operations and management while providing a high level of flexibility. This paper describes some of the history involved with the development and current use of IWTS as a comprehensive waste management tool as well as a discussion of IWTS deployments performed by the INL for outside clients.

Waste management spans a wide range of activities including: work group interactions, regulatory compliance management, reporting, procedure management, and similar activities. The IWTS documents these activities and performs tasks in a computer-automated environment. Waste characterization data, container characterization data, shipments, waste processing, disposals, reporting, and limit compliance checks are just a few of the items that IWTS documents and performs to help waste management personnel perform their jobs.

Throughout most hazardous and radioactive waste generating, storage and disposal sites, waste management is performed by many different groups of people in many facilities. Several organizations administer their areas of waste management using their own procedures and documentation independent of other organizations. Files are kept, some of which are treated as quality records, others not as stringent. Quality records maintain a history of: changes performed after approval, the reason for the change(s), and a record of whom and when the changes were made. As regulations and permits change, and as the proliferation of personal computers flourish, procedures and data files begin to be stored in electronic databases. With many different organizations, contractors, and unique procedures, several dozen databases are used to track and maintain aspects of waste management. As one can see, the logistics of collecting and certifying data from all organizations to provide comprehensive information would not only take weeks to perform, but usually presents a variety of answers that require an immediate unified resolution. A lot of personnel time is spent scrubbing the data in order to determine the correct information. The issue of disparate data is a concern in itself, and is coupled with the costs associated with maintaining several separate databases.

In order to gain waste management efficiencies across an entire facility or site, several waste management databases located among several organizations would need to be consolidated. The IWTS is a system to do just that, namely store and track containerized waste information for an entire site. The IWTS has proven itself at the INL since 1995 as an efficient, successful, time saving management tool to help meet the needs of both operations and management for hazardous and radiological containerized waste. Other sites have also benefited from IWTS as it has been deployed at West Valley Nuclear Services Company DOE site as well as Ontario Power Generation nuclear power facility in Canada.

HISTORY

The INL has managed waste for many years. Throughout the INL's history, waste management was performed by many different groups of people in many facilities within an 890 square mile (2305 Km^2) region. There were more than six different Management and Operating (M&O) contractors at one time managing their own programs at the INL, working under the Department of Energy (DOE). Each M&O facility

managed waste using their own procedures and maintained their own documentation.

In order to gain waste management efficiencies across the site, a project was created to consolidate several waste management databases located all over the site. One of those systems was the IWTS.

IWTS OVERVIEW

The IWTS is a database system that currently manages radioactive, mixed, and hazardous containerized waste throughout the entire lifecycle from waste declaration to disposal. This includes the tracking of waste during generation, characterization, treatment, storage, transportation, and disposal. The IWTS provides information necessary to help facility personnel properly manage and demonstrate compliance with federal, state, and local regulations, and facility-specific permits and Safety Analysis Report (SAR) requirements. The IWTS technology includes bi-directional replication between servers, providing high reliability and a means for system expansion. Hand-held tools in conjunction with container bar codes are used to perform operational tasks such as inventories, shipment receipts, container information, and simple inventory relocation tasks.

Several standard operational and management reports are contained within the IWTS. Reports such as current inventories at a particular facility, generation quantities, number of days a container is stored at a particular area, and similar functions represent operational reports. Other reports such as total amounts of waste generated, stored, and disposed at the site are used primarily for management. Ad hoc queries can be generated at any time from a user request.

A graphical user interface provides easy, intuitive, navigation throughout IWTS utilizing the Windows[1] graphical environment. Drag and drop, double clicks, tabs, and most other standard Windows features are incorporated into IWTS.

Some of the fundamental stages that all waste management includes are:

- Processes
- Places
- People
- Procedures

A discussion of each stage follows describing how the IWTS helps personnel to properly manage waste.

PROCESSES

Waste management for most any business or government entity that generates waste can be described as having some or all of the following activities:

- Generation
- Transportation
- Treatment
- Storage
- Disposal

These activities are common to most waste generators, and hence can be described and modeled in an electronic system. The IWTS provides mechanisms to capture all of these waste management activities such that they are integrated to provide a comprehensive, single point system. Fundamental to IWTS is the idea of profiles and tasks. A profile is a group of related information describing an entity whether it be a waste type or waste stream, a container and its physical attributes, places, or people themselves. Tasks represent processes such as: treatments, shipping, disposal, and inventories performed at a particular facility. Modeling and integrating all of these physical activities or functions in an electronic system is at the heart of the IWTS.

Generation

Generators may not always understand all the technical aspects of the waste being generated. Usually, a waste specialist gets involved to help the generator characterize the waste and decide on the disposition path. This is where the generators and/or waste specialist personnel begin to create a waste profile. The IWTS provides easy entry screens that facilitate getting all necessary information into the system.

Once a waste (material) profile has been filled out, a three level approval cycle begins. Whoever is responsible for making sure that the data is true and accurate to the best of their knowledge signs the certification signature. Before a certification signature is placed in the system, IWTS runs some simple checks to make sure certain fields are filled out correctly and that some fields are not left blank. If all passes, then the certification signature is allowed into the system. The same process holds for a review signature. The reviewer looks over the data entered as an independent verification to ensure the data is true and accurate. A final approval signature is required which approves that the waste disposition path listed in the profile is acceptable. See Fig. 1 for an example of a material profile.

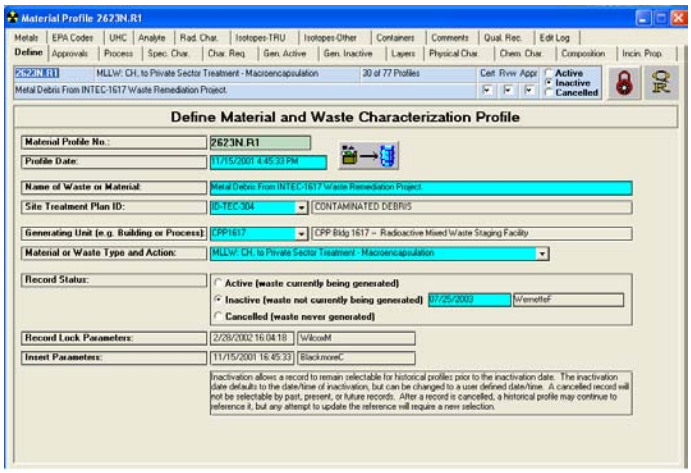


Figure 1 – IWTS Material Profile

[1] Microsoft Corporation

As the characterization data is entered and approved for a waste or material profile, individual containers can now be associated to that material profile. Each container is described by a separate container profile. This information characterizes the container itself. Quantities of waste, volumes, container types, location, labels, and other characteristics are entered on this profile. All container profiles are linked to a particular waste profile to describe its contents. The same type of approval scheme used for material profiles is used to approve each container profile.

Transportation

When a container has been generated and the material profile describing the waste stream has all been approved, the container(s) are ready for shipment to a storage, treatment, or disposal facility. Physical shipments are documented on "shipment" tasks that associate the individual container(s) to a single, common shipment task. Some general shipping information is entered and a check is made to ensure any additional signatures are completed.

Once the proper signatures have been applied, the sender executes the shipment task. This execution runs many limit evaluations to determine if this shipment can go to the selected facility without exceeding any of the limits that have been established for that facility. Limits are checked based on established regulations, permits, and safety analyses. Physical inventories, weights, volumes, or fissile radionuclide limits are examples of quantities that are checked against specified limits before an actual shipment is allowed to proceed. If these limit checks pass, then the physical shipment can proceed. At this stage, no transfer of inventory takes place. Once the shipment is received at the destination facility, the receiver executes the IWTS shipment task again to make sure that no limits will be exceeded in his facility. There may have been other shipments processed during the time it took for the original shipment to arrive at the receiving facility. This final execution now performs the transfer of inventory to this destination facility.

Uniform Hazardous Waste Manifests are also developed within IWTS to support hazardous waste shipments. What used to take approximately 3 days to create and up to 2 weeks to process (manifests) now takes only hours. IWTS brings consistency and speed to the process utilizing information already stored within the IWTS.

Treatment

Modeling a physical waste treatment process is handled through another task in IWTS called a "process" task. Treatment processes usually involve transferring waste from one or more container(s) to one or more other container(s). As this processing is performed, a secondary waste stream is generated. For radioactive waste, radionuclides are partitioned in IWTS automatically into all receiving container(s). Once this task has been executed, each container associated with it now retains a genealogy as to what source (parent) container(s) supplied waste to it or what receiving (daughter) container(s) received waste from it.

IWTS is able to accommodate many different types of treatment processes. Repackaging, compaction, incineration, encapsulation, overpacking, stabilization, and sizing operations are a few of the processes that have been modeled in IWTS. Sometimes a particular process is so unique that modifying the core IWTS is not practical. In this case, process specific applications (PSA) are written as an attached application linking all pertinent IWTS data to and from the PSA. This has proven very useful at the INL. It allows the facility-specific processes to be custom built while maintaining a link to IWTS.

Storage

Managing storage areas require accurate inventories and regulatory limit compliance. As mentioned with shipping tasks, IWTS performs checks to validate limit compliance when shipping containers to a storage area. Each area or facility maintains its own set of regulatory requirements that need to be preserved. Knowing what waste is stored in a facility has proven quite challenging to operations. Keeping a near real-time inventory for those facilities that have high volume of traffic requires a lot of dedication to tracking. In order to streamline the process of keeping track of inventory, the IWTS provides support with hand-held tools and bar coding.

Inventory tools facilitate operations personnel in collecting and retrieving the data they need to perform several operational tasks. Most sites have issues involving data entry delays, data quality (inaccuracies), labeling problems, and incorrect physical inventories, as was the case with the INL. Barcodes provided the answer for speed and accuracy necessary to help in these areas. Figure 2 shows an example of temporary storage of multiple containers located at the INL.

Figure 2 – Containers Stored at the INL

Containers are stored in open areas inside and outside, therefore it seemed reasonable that a "non-wired" solution was necessary for any type of scanning device. With the adoption of the Institute of Electrical and Electronic Engineers (IEEE) 802.11 standard for Wireless Ethernet in 1997, wireless hand-held scanning devices were chosen for the task of scanning containers. This wireless solution provides easy setup into any facility inside or outside for hands free movement. Symbol Technologies[2] wireless hand-held devices were chosen for this task.

[2] Symbol Technologies – PPT2740

Incorporating wireless hand-held scanners into operation's activities, the INL was able to narrow the time lapse between what is really happening in the field and what is reflected in the tracking system. IWTS was able to bring a "near real-time" aspect to container tracking with the use of these scanning tools. Inventory time has been reduced by 30%, with much improved accuracy. It must be understood that technology in of itself does not perform the job of waste management. It is only a tool that must be utilized in the hands of a skilled technician. Value is only realized in the use of the tool with the experience, expertise, and process knowledge of the user.

Disposal

Disposal of waste usually implies the final resting place or disposition of that waste whether on-site or off-site. A final disposition of waste at an area or facility is performed in IWTS under a "disposal" task. The function of a disposal task is not only to perform compliance limit checks for that facility, but also to take all containers associated with that task and mark them as no longer active in the system. A non-active or decommissioned container in IWTS means that it can no longer be in inventory at any storage facility. This is useful for reporting purposes.

PLACES

Physical places such as buildings, pits, landfills, trucks, stacks, etc. are profiled within IWTS to handle almost any type of generation, storage, treatment, or disposal area. The IWTS uses a hierarchy model to describe a place from the highest level (facility) down to a particular grid if necessary. Each place may have limits associated with it. Physical, chemical, and radiological limits are some types of compliance limits that are modeled in order to provide objective evidence of compliance. Some of these drivers come from federal regulations while others may be from a safety analysis performed for a particular building or storage area. Some places, such as a subsurface disposal area (SDA), may require performance assessments be made to ensure protection to the public's health and safety. These assessments assure external exposure to the waste and concentrations of radioactive material which may be released into the soil, water, plants or animals results in an effective dose equivalent that does not exceed 25 mrem/yr to any member of the public from any exposure pathway. Once experts have performed these assessments, the resulting radionuclide limits are entered into the IWTS to help make sure no disposal of waste will exceed these values. Areas on-site as well as off-site can all be modeled within the IWTS allowing for a very flexible system.

PEOPLE

In a typical waste management environment, there are many people required to perform varying functions. There are groups of people ranging from the generators of the waste itself to the people responsible for final disposition. Each group of people has their function(s) throughout the process. There are those who may only move waste from one area to the next. Others are responsible for characterizing the waste while determining the final disposition of that waste. All groups are represented in IWTS with varying levels of authority to perform actions within IWTS. The IWTS allows for people to belong to certain user groups with specific permissions to allow only those actions necessary to do their job. An "Operation" group is defined within IWTS for operators at Ontario Power Generation (OPG). Figure 3 shows a civil maintainer at OPG performing his job of processing waste.

Figure 3 – OPG Civil Maintainer Processing Waste

One group of people who may not be directly tied to the operational side of managing waste is managers either from within the facilities or those who oversee the regulatory compliance. Reports are accessed by the oversight managers, who need more of a read-only account in order to view the processes and/or the regulatory compliance issues. Information pertaining to inventories, generation estimates, or amounts of waste disposed are very important.

PROCEDURES

Procedures collect and administer the business practices of your operation. IWTS was designed around the business practices of waste management with an operational emphasis, in order to provide ease of use in collecting the data. Procedures help make the IWTS succeed. In of themselves, procedures are meaningless. It takes management support to enforce compliance with those procedures in order to run a smooth operation. Since IWTS was designed around an "operational" philosophy, no container of waste is moved, treated, stored, or disposed of without information being entered into IWTS.

The IWTS structure is such that certain checks are made to help in the performance of the user's job. People must still enter data, see to it that the data is entered in a timely manner and that certain sequences are adhered to. The IWTS helps to organize the flow of information but cannot take the place of strict adherence to the procedures that are already in place. Without operations support in following procedures set up for

this system, it would be just another "database" with a data specialist typing in data long after the action had been performed.

REPORTING

Before the IWTS, multiple databases were used to track waste information. As a result, inconsistent reports were generated across the site. Each facility interpreted regulations, permits, and operational procedures slightly different than the next facility. The manpower expended to rectify the inconsistencies was considerable. Because IWTS brought most facility waste tracking databases under one roof, reporting was finally done in a consistent format. The IWTS provides many useful reports, which help everyone do their job from operations personnel to the managers responsible for reporting regulatory compliance. The IWTS reports are broken into five main categories:

- Regulatory
- Operational
- Management
- Web
- Ad hoc

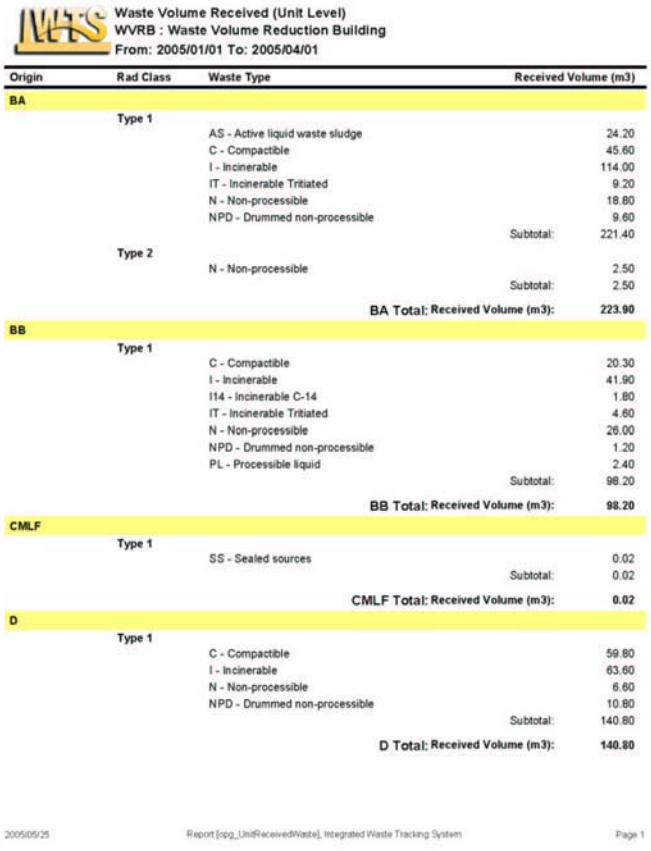
Regulatory

Regulatory reports are mandated by the state, the local DOE office, Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), EPA, the site treatment plan (Consent Order), and other government sites. Each agency describes their requirements through their manuals, orders, and other regulatory documents. Given these documents as the requirements, IWTS produces standard regulatory reports that have been certified, verified & validated (V&V). These reports are easily modified to suit continually changing requirements.

Problems keeping RCRA 90-day temporary storage areas from not exceeding their time limit were alleviated by developing a report in the IWTS that would reveal the current number of days in storage. With this information displayed to the facility representative, it was easy to see those containers approaching the 90-day limit. With new RCRA rules imposed on waste management especially for universal accumulation areas, IWTS can easily adapt to changing time frames whether it be 90 days or 1 year.

Operational

Facility representatives can use operational type reports created within IWTS to help manage their inventories, 90-day temporary accumulation areas, shipments performed, volumes of waste stored, and other similar activities. Other reports include reference data such as nuclide information, EPA codes, chemical lists, and many others. These reports are very handy for operational users who need this type of information every day to help do their jobs. Received waste at a particular facility is very important. A typical IWTS operational report is shown in Fig. 4.



Waste Volume Received (Unit Level)
WVRB : Waste Volume Reduction Building
From: 2005/01/01 To: 2005/04/01

Origin	Rad Class	Waste Type	Received Volume (m3)
BA			
	Type 1		
		AS - Active liquid waste sludge	24.20
		C - Compactible	45.60
		I - Incinerable	114.00
		IT - Incinerable Tritiated	9.20
		N - Non-processible	18.80
		NPD - Drummed non-processible	9.60
		Subtotal:	221.40
	Type 2		
		N - Non-processible	2.50
		Subtotal:	2.50
		BA Total: Received Volume (m3):	**223.90**
BB			
	Type 1		
		C - Compactible	20.30
		I - Incinerable	41.90
		I14 - Incinerable C-14	1.80
		IT - Incinerable Tritiated	4.60
		N - Non-processible	26.00
		NPD - Drummed non-processible	1.20
		PL - Processible liquid	2.40
		Subtotal:	98.20
		BB Total: Received Volume (m3):	**98.20**
CMLF			
	Type 1		
		SS - Sealed sources	0.02
		Subtotal:	0.02
		CMLF Total: Received Volume (m3):	**0.02**
D			
	Type 1		
		C - Compactible	59.80
		I - Incinerable	63.60
		N - Non-processible	6.60
		NPD - Drummed non-processible	10.80
		Subtotal:	140.80
		D Total: Received Volume (m3):	**140.80**

2005/05/25 Report [dpg_UnitReceivedWaste], Integrated Waste Tracking System Page 1

Figure 4 – Typical IWTS Received Waste Report

Auditors can use these reports to help in their assessments of inventory compliance and container inspections where they need to know certain basic information about the container and the associated waste inside. Other audit functions could include the need to provide evidence of regulatory compliance to specific facility permits or SAR's.

Management

Summary level reports are typically generated for management to detail total amounts of waste generated, shipped on-site, shipped off-site, treated, and disposed. These reports are usually generated allowing the user to choose specific periods of time, locations (facilities), and types of waste. Prior to the IWTS, these types of reports would take days or weeks to generate. Now, through the use of IWTS, these reports take only minutes.

Web

An IWTS web server accessible to all personnel within the company intranet firewall, without requiring an IWTS account, is also utilized supplying canned reports and some minimal ad-hoc reports. These reports serve to provide quick responses for people who are not intimately familiar with IWTS but still have a need for information. Standard web browser screens provide easy navigation to a menu of reports. Reports such as current inventory, container information, profiles awaiting approvals, generated waste totals, etc., are a few examples of the type of reports available. Emergency response crews can quickly access the site intranet, access the IWTS home page, find the

container information report, and determine the contents of any container that may be in question. With this information readily available from virtually any place on site, emergency response teams can quickly determine appropriate corrective actions.

Ad hoc

Ad hoc queries are performed on a daily basis. Managers, generators, waste specialists, packaging and transportation personnel, and a whole host of other groups find data within IWTS not only necessary for their job but also very useful for keeping communication channels open between different groups working together to get waste dispositioned. The data structure developed for IWTS was developed in such a manner that with a little knowledge of the system itself, these ad hoc queries (reports) are as flexible as any question asked.

QUALITY RECORD

Due to the constant operational handling of waste and the reporting visibility to all IWTS customers, IWTS hard copies (printouts) kept for quality records, were practically obsolete the minute the documents were printed. Audits found that the hard copies maintained in files were not always aligned with the actual database itself. The question of "which is the record?" was asked repeatedly. Knowing that the true "record" was always the electronic database, IWTS underwent an improvement to make the data withstand audits as "the" quality record. Decisions were made by a steering committee that any change made to a profile after that profile had been fully approved got recorded in a log file accessible to anyone for review. The "before" and "after" information was recorded along with a reason for the change, the user, date and time. If changes being made were extensive, or changed the whole intent of the profile, the quality record function would force the user to create a completely new profile requiring a complete review and approval cycle.

TECHNOLOGY

The technologies used in the IWTS system are standard off-the-shelf hardware and software based on a Microsoft[3] platform using either SQL Server or a Sybase[4] database engine and Symbol[5] wireless hand-held devices. Flexibility can only be accomplished if the tool being used is created with ease of use and expandability in mind. IWTS incorporates many of the features found in any modern graphical environment. The use of selectable preferences has proved invaluable when deploying IWTS to other sites and/or facilities. Some sites require approvals for intra-facility shipments while others do not. The ability to turn on and off features such as quality record status, password criteria, user profiles, automatically generated email notifications, annual approval requirements, and many more, allow IWTS to be adapted to practically any facility.

Notification of software updates is easily processed at the time of login. A message prompts the user that a new version of IWTS is available and provides a hot-link to the IWTS web page for download. Nothing is as easy for providing a complete installation of new software than clicking a button on a web page and having it fully install from the web. No formal knowledge of computers is necessary for this process. The fact that this system uses a client server relationship allows full processing within the facility where the operational work is accomplished. It also maintains complete duplication of data throughout the server network via bi-directional replication technology. This technology replicates all data from one server to the next providing high reliability to the overall system. If one server goes down, users can be "mapped" to any of the other functional servers. Waste operations use of IWTS does not stop. An additional server installed at that location with an existing network or telephone line easily performs expansion of IWTS to any other owned facility or outside company.

INTEGRATION

Integration is one of the most important aspects of the IWTS. It brings together people of all areas of waste management providing common dialog for all to communicate with each other. IWTS helps to remove the barriers that exist when waste generators and waste management personnel are discussing waste profiles, containers, and storage topics.

Prior to the IWTS, every INL facility had their own way of doing business relating to waste management. Some facilities used small databases tracking only characterization data. While other separate databases kept characterization data for the waste streams, others dealt with management of treatments, or just disposal activities, or maybe just transportation data. Summary reports were a compilation of multiple databases all with different nomenclature, characterization data, and missing data. The level of effort required to compile this summary information to our reporting customers (State, EPA, DOE, etc.) used to take in excess of 3 to 6 months. The IWTS system has replaced all those systems to provide a single, comprehensive integrated system.

DEPLOYMENTS

IWTS has been deployed at two other locations. The West Valley Demonstration Project DOE site needed a tracking system that was a multi-user system with security built in. IWTS fit the bill and was chosen among other DOE systems to be the system of choice. They have been in production mode since January 2001. The response has been great with very little INL support required.

The second deployment to date has been at the OPG site located in Toronto Ontario Canada. The IWTS was modified specifically for their use with low and intermediate level radioactive waste. It was proven that IWTS could be modified keeping its basic structure intact. This system was put into

[3] Microsoft Corporation
[4] Sybase Incorporated
[5] Symbol Technologies

production in December 2004. Early feedback has been positive with additional modifications requested.

Along with internal deployments to Argonne National Laboratory West (now combined with the INL) and the Naval Reactor Facility located on the INL, it has been proven that the Idaho National Laboratory produces a quality product and performs all necessary project management required to create a system, which meets the customer's requirements. This includes migrating legacy system data into a flexible, quality system used by many organizations including operations. The INL maintains resources, which have the experience in design, development, testing, data migration, reporting, and system installation and operation.

CONCLUSION

The IWTS has been a tremendous unifying force for the INL providing a comprehensive waste management tool. No other waste management system reviewed at the time was able to perform the multitude of functions the INL required in order to resolve some of our waste management issues. Developing IWTS was a project that became successful as it was intentionally designed around an operational philosophy. It was crucial that the required data be embraced by the people who were responsible for getting that data into the system.

The IWTS has been operational since 1995 and has exceptional availability statistics that assures operation of a 24/7 availability. The IWTS can be adapted to suit almost any type of waste management process providing a flexible tool to help reduce costs. The efficiencies gained by using IWTS are innumerable. IWTS provides such benefits as hazardous shipping manifests, 90-day temporary accumulation area reports, genealogies for container processing, and meets quality record requirements for maintaining information as an electronic record. Individuals who once spent the majority of their time documenting the waste now spend most of their time dis-positioning that waste, not managing the paperwork. The system also utilizes tools such as wireless networks, hand-held inventory tools, barcode readers, and web interfaces that bring the power of this system to the worker in the field supporting tasks and reducing paperwork associated with managing waste. The IWTS at the INL has proven its value as a comprehensive waste management tool. Not only does IWTS support operational activities, but it also helps bring groups of people together under a common communication platform providing an outstanding waste management tool.

ACKNOWLEDGEMENTS

Figures 3 and 4 courtesy of Ontario Power Generation.